

Quadrivium I

Lesson Plans

Week 9: Counting

Overview: This week we pass from geometry to numbers. Like in Chapters 1 and 2, we begin with playful activity to accustom ourselves to the objects involved. Later, we will give proofs.

Cultivated Virtue: *Attention*: Strictly speaking, attention is not a virtue. However, it is a faculty that is radically transformed by prayer and virtue. Consider the following excerpt from Simone Weil's essay, "Waiting for God."

Happy then are those who pass their adolescence and youth in developing this power of attention.

School children and students who love God should never say: "For my part I like mathematics"; "I like French"; "I like Greek." They should learn to like all these subjects, because all of them develop that faculty of attention which, directed toward God, is the very substance of prayer.

If we have no aptitude or natural taste for geometry, this does not mean that our faculty for attention will not be developed by wrestling with a problem or studying a theorem. On the contrary it is almost an advantage.

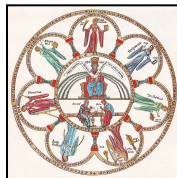
It does not even matter much whether we succeed in finding the solution or understanding the proof, although it is important to try really hard to do so. Never in any case whatever is a genuine effort of the attention wasted. It always has its effect on the spiritual plane and in consequence on the lower one of the intelligence, for all spiritual light lightens the mind.

If we concentrate our attention on trying to solve a problem of geometry, and if at the end of an hour we are no nearer to doing so than at the beginning, we have nevertheless been making progress each minute of that hour in another more mysterious dimension. Without our knowing or feeling it, this apparently barren effort has brought more light into the soul. The result will one day be discovered in prayer. Moreover, it may very likely be felt in some department of intelligence in no way connected to mathematics. Perhaps he who made the unsuccessful effort will one day be able to grasp the beauty of a line of Racine more vividly on account of it. But it is certain that this effort will bear its fruit in prayer. There is no doubt whatever about that.

Throughout this week, be attentive to the quality of your attention. If eyes are the window to the soul, then attention is the window to the heart. What's in your heart? Loving your schoolwork may feel like an overwhelming ask of you. For the love of God, can you attend to your schoolwork?

Assessment Preparation: Chapter 9 will be assessed through students being able to complete and review estimates like the ones they will be presented with in the exercises.

Looking Ahead: This is a light week, so it is a good time to work on our preparations for music and astronomy. Try to enjoy the playful approach this week while also working our preparations into your routines.



Monday

Day 1 Journal Entry: Add a suitable heading. For example, "Chapter 9 Day 1—Counting."

- Complete Exercises 1, 2, and 3.
 - *Be sure to write the prompt for each exercise.*
 - *Use impeccable grammar: Be clear, concise, accurate, and eloquent.*

Tuesday

- II. **Recitation/ Prayer:** Begin by reciting the “Rules of a Virtuous Classroom” and praying “A Prayer Before Study” of St. Thomas Aquinas
- III. **Opening Reading Excerpt:** Carefully and critically read the following excerpt from Dr. Peter Ulrickson. We will be reading from his essay on Games each day this week.

Games

Plato's admirers and detractors alike concede that his writings span a wide ground; it has been said that the history of philosophy is a series of commentaries on Plato. Even Plato's most ardent disciples, though, cannot claim that he went so far as to write about the atom bomb.

The Academy's founder got his mathematical ideas in Italy, from the followers of Pythagoras, while avoiding political turmoil at home. Two millennia later, turmoil in Italy and beyond led a different thinker, Enrico Fermi, to seek refuge even further abroad. The winner of the 1938 Nobel Prize in Physics ended up in the United States, and by the summer of 1945 he was in New Mexico for the trial detonation codenamed Trinity.

At the time of the explosion, Fermi stood with other scientists at a close, but safe, distance from the blast. When the shock wave reached them, Fermi dropped some small bits of paper and watched what they did as they fell to the ground, driven by the wind that the detonation caused. He then briefly did a mental calculation and told those who were with him his estimate of how strong the explosion had been. Fermi's result turned out to be quite close to the one derived from complex instruments stationed near the bomb.

Ponder this excerpt as you complete your work. Be sure to jot down any interesting questions or thoughts you'd like to share during the next class meeting.

- IV. **Reading Excerpt from the Chapter:** Reread sections 9.1 and 9.2
- Critically read and annotate both sections.
 - Try to find one point or question to discuss in our weekly check in.
- V. **Day 2 Journal Entry:** Add a suitable heading. For example, “Chapter 9 Day 2—Words and Time”
- **Cultivated Virtue: Solitude.** Seek solitude while working on your journal entry.
 - Complete Exercises 4, 5, 6, and 7
 - *Be sure to write the prompt for each exercise.*
 - *Use impeccable grammar: Be clear, concise, accurate, and eloquent.*
- VI. **Close in Prayer:** As with all things, conclude with gratitude in prayer.

Wednesday (*Virtual Office Hours Day)

- I. **Recitation/ Prayer:** Begin by reciting the “Rules of a Virtuous Classroom” and praying “A Prayer Before Study” of St. Thomas Aquinas
- II. **Opening Reading Excerpt:** Carefully and critically read the following excerpt from Dr. Peter Ulrickson. We will be reading from his essay on Games each day this week.

Games

Enrico Fermi was able to make this rapid, accurate estimate because he had learned over many years how to see the key features of a given system of quantities, making good guesses by relating unknown things to those that were more familiar to him. He was a genius scientist, but his method can be taught, even if we will not ever have his physics prowess.

The puzzles of this opening chapter are in some way like Fermi's calculation. One difference is that they do not involve knowledge of physical parameters, like the acceleration due to gravity or typical air resistance. Those are things that students pick up when they study physics or chemistry. This book's estimates involve things accessible without prior technical training.

This essay opened with Plato, and the observation that he knew nothing about nuclear weapons. It turns out that he did, however, know something about what Fermi did at the test. In Plato's late work called *Laws*, a figure called "the Athenian" speaks about mathematics and education. He advises that a society should use game to introduce children to arithmetic. He says that the Egyptians do this, with puzzles about how to distribute garlands or arrange wrestling tournaments.

- III. **Reading Excerpt from the Chapter:** Done during weekly check in time.
 - Review estimates that were made on the first two days.
 - Where do there seem to be overestimates? Where are there underestimates?
 - What important qualifications were omitted or not given due weight?
 - What is the range of reasonable estimates? How narrow can it be made?
- IV. **Day 3 Journal Entry:** Add a suitable heading. For example, “Chapter 9 Day 3—Principles for Estimation (1)”
 - **Cultivated Virtue: Solitude.** Seek solitude while working on your journal entry.
 - Complete Exercises 9 and 10.
 - *Be sure to write the prompt for each exercise.*
 - *Use impeccable grammar: Be clear, concise, accurate, and eloquent.*
- V. **Close in Prayer:** As with all things, conclude with gratitude in prayer.

Thursday

- I. **Recitation/ Prayer:** Begin by reciting the “Rules of a Virtuous Classroom” and praying “A Prayer Before Study” of St. Thomas Aquinas
- II. **Opening Reading Excerpt:** Carefully and critically read the following excerpt from Dr. Peter Ulrickson. We will be reading from his essay on Games each day this week.

Games

The youthful arithmetical games of Plato's *Laws* are not deadly, but Fermi's bomb is. War and death are, though, under the surface of Plato's dialogue *Timaeus*, introduced earlier in an essay on geometry. Socrates explains at the beginning of *Timaeus* that he wants to understand what the best city looks like when it is in conflict with other cities. The dialogue of *Timaeus* takes place the day after a discussion of the best city in the abstract. Now Socrates wants to understand how this good polity would respond when faced with the strains brought on by the inevitable limitation and strife of life in the world.

Socrates notes that a superficial sophist, someone who wanders from place to place teaching convenient tricks of argumentation for pay, will not be able to present how the virtuous statesman would act in such a situation. Being rooted in a particular place both limits and frees. The artful speech of the rhetorician is hemmed in by the humbling realities of a concrete place. At the same time, though, the speaker is elevated by this very limitation, since only the encounter with these natural limits will direct his theorizing away from the fanciful and towards the truly good.

There are no right answers to these questions of this chapter. It is also true that mathematics is exact. These two statements are both true.

The finiteness that encumbers us leads us to battle with others for the resources of the earth. In times of peace we strive for another kind of mastery, discovering new and clearer ways to speak about the order within created things. Even as our speech becomes more accurate, it ought to remain playful, as we keep in mind the memory of our natural limits.

Ponder this excerpt as you complete your work. Be sure to jot down any interesting questions or thoughts you'd like to share during the next class meeting.

- III. **Reading Excerpt from the Chapter:** Review section 9.2
- IV. **Day 4 Journal Entry:** Add a suitable heading. For example, “Chapter 9 Day 4—Principles for Estimation (2).”
 - **Cultivated Virtue: Solitude.** Seek solitude while working on your journal entry.
 - Complete Exercises 11 and 12.
 - *Be sure to write the prompt for each exercise.*
 - *Use impeccable grammar: Be clear, concise, accurate, and eloquent.*
 - *Start working ahead for Astronomy. Complete exercise 11 from chapter 8.
- V. **Assessment Prep:** Review the assessment preparation on the first page. What do you need to do before Monday to prepare to excellently demonstrate excellent work? What are you willing to do? **Make a plan. Execute plan.**
- VI. **Close in Prayer:** As with all things, conclude with gratitude in prayer.

Friday

- I. **Recitation/ Prayer:** Begin by reciting the “Rules of a Virtuous Classroom” and praying “A Prayer Before Study” of St. Thomas Aquinas
 - II. **Opening Reading Excerpt:** Reread the cultivated virtue of the week on the first page. Reflect on how you have grown this week in that virtue.
 - III. **Reading Excerpt from the Chapter:** Instead of reading from the Chapter, go outside and make estimates involving things that are seen. How far away is that distant building? How tall is that tree? How many trees are in that park? How many gallons of water in that pond? How many toilets in that office building? How many offices? As much as possible, you should come up with your own questions, and you should evaluate the estimates themselves.
 - IV. **Assessment Preparation:** Today’s assignment is already practice for the Week 9 Assessment. Prompts for the assessment are given below.
 - Work on executing your plan.
 - **Discuss your estimates with a classmate.**
 - V. **Close in Prayer:** As with all things, conclude with gratitude in prayer.
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Week 9 Assessment

- Be able to complete and review estimates like the ones in the exercises.
 - Where do there seem to be overestimates? Where are there underestimates?
 - What important qualifications were omitted or not given due weight?
 - What is the range of reasonable estimates? How narrow can it be made?

